

Reply to Office Action dated October 17, 2007

AMENDMENTS TO THE CLAIMS

This listing of claims will replace all prior versions and listings of claims in the instant application:

1. (Currently amended) A method for determining the hydraulic flow rate in a pump driven by a synchronous electric motor (12), said motor (12) being of the type comprising a rotor (14), equipped with a permanent magnet, which is rotation-driven by the electromagnetic field generated by a stator (16) equipped with pole pieces (18) with relevant windings, the method comprising the step of:

indirect measuring of said flow rate through the acquiring at least one pump operation variable,

comparing the value of said variable within a predetermined correlation table and determining a corresponding flow rate value, and

determining a corresponding flow rate value

characterised in that wherein said step of acquiring said at least one pump operation variable acquires a load angle or delay θ , i.e. a phase shift angle between a network voltage applied to the motor (12) terminals and the counter-electromotive force generated by adding the effects of the stator (16) flux and of the flux induced by the rotor (14) permanent magnet rotation and in that said correlation table links flow rate values and load angle values.

2. (Currently amended) A method for determining the flow rate in a pump according to claim 1, characterised in that it further comprises comprising a calibration step wherein said correlation table is filled by means of experimental tests, theoretical simulations or computer simulations.

3. (Currently amended) A method for determining the flow rate in a pump according to claim 1, characterised in that wherein said step of acquiring said load angle or delay θ occurs continually.

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4. (Currently amended) A method for determining the flow rate in a pump according to claim 1, characterised in that it further comprises comprising a step of acquiring a further pump operation variable like a network voltage applied to the terminals of the motor (12).
5. (Currently amended) A method for determining the flow rate in a pump according to claim 1, characterised in that it further comprises comprising a step of acquiring a further pump operation variable like the magnet temperature of the rotor (14).
6. (Currently amended) A method for determining the flow rate in a pump according to claim 1, characterised in that it further comprises comprising a step of compensating said flow rate value when the motor electric supply voltage varies; this compensation being obtained by means of a further predetermined correlation table.
7. (Currently amended) A method for determining the flow rate in a pump according to claim 1, characterised in that it further comprises comprising a step of measuring a temperature of said rotor (14) to compensate the value of said flow rate when the temperature changes and by means of a further predetermined correlation table.
8. (Currently amended) A method for determining the flow rate in a pump according to claim 1, characterised in that it further comprises comprising a step of sensing a signal being proportional to the residual induction (B_R) of the ferromagnetic material of the rotor (14) and dependent on the operative temperature, by means of an analogue Hall sensor (20A).
9. (Currently amended) An electronic device (10) for determining the hydraulic flow rate of a pump driven by a synchronous electric motor (12), said motor (12) being of the type comprising a rotor (14), equipped with a permanent magnet, which is rotation-driven by the electromagnetic field generated by a stator (16) equipped with pole pieces (18) with relevant windings, and comprising:

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a processing unit (22) receiving at its input a first signal coming from a magnetic flux sensor (20, 20A) of the rotor (14) and being equipped with or associated to a memory portion storing a correlation table linking hydraulic flow rate values and values of an operation variable of the pump motor characterised in that

wherein said pump operation variable is a load angle or delay θ , i.e. a phase shift angle between a network synchronism signal (24) and a counter-electromotive force generated by adding the effects of the stator (16) flux and of the flux induced by the rotor (14) permanent magnet rotation, and in that

wherein said processing unit (22) compares said load angle unit said operation variable value stored in said correlation table in order to determine a corresponding hydraulic flow rate value.

10. (Currently amended) An electronic device according to claim 9, characterised in that
wherein said sensor (20) is a digital Hall sensor.

11. (Currently amended) An electronic device according to claim 9, characterised in that
wherein said sensor (20A) is an analogue Hall sensor.

12. (Currently amended) An electronic device according to claim 9, characterised in that
wherein it has a third signal input to receive a signal (26) being proportional to the effective value of the network voltage obtained by means of a voltage regulator (28) to generate a signal (50) being proportional to the hydraulic flow rate completely independent from the electric supply voltage.

13. (Currently amended) An electronic device according to claim 11, characterised in that it comprises further comprising an inner counter (52) to increase the count of the load angle θ at each rising edge of the network clock signal (24).

14. (Currently amended) An electronic device according to claim 11, characterised in that

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wherein said analogue sensor (20A) detects a signal being proportional to the residual induction (B_R) of the ferromagnetic material of the rotor (14) and dependent on the operative temperature.